

LABOR MARKET ANALYSIS OF THE

LABOR SUPPLY IN INFORMATION TECHNOLOGY OCCUPATIONS

Testimony to the California Legislature — The Joint Hearing
of the Senate Select Committee On Economic Development,
and the Assembly Committee On Consumer Protection,
Governmental Efficiency and Economic Development

Presented by

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I N T R O D U C T I O N

Good afternoon. My name is Richard Holden and I am Chief of EDD's Labor Market Information Division. I am pleased to be here to provide our analysis of the labor market for information technology occupations in California.

My talk will cover four areas:

- Characteristics and recent trends of the information technology workforce including employment in eight information technology occupations in nine high technology industries in California.
- Recent trends in the nine high technology industries, including projections for these industries, as well as occupational projections for four of the eight information technology occupations.
- Evidence of supply/demand problems as demonstrated by 1) annual earnings growth in the nine industries; and 2) employer survey data on the difficulty in hiring workers in several information technology occupations.
- Finally, brief observations relating to factors affecting the demand for information technology labor and the pool of possible applicants.

Our analysis is based on data collected by the U.S. Bureau of Labor Statistics, EDD's Labor Market Information Division, and

EDD's partners in 38 local areas covering all of California.

Before I start, I would like to briefly note two papers that concern this issue. The first is the testimony of Robert Lerman at the Urban Institute. Dr. Lerman indicated in testimony before the U.S. Senate that evidence for a labor shortage is inconclusive based on trends in real wages and evidence that workers in information technology enter from other fields.

The second study was completed for the Information Technology Association of America (ITAA) and concludes that there may be 346,000 vacant information technology positions in the United States — roughly 10 percent of the 3.4 million employees in these occupations. This study was based on a survey of 1,500 companies nationwide with 100 or more employees. The results are based on 532 companies responding, a 36 percent response rate. You may be aware that the U.S. General Accounting Office is issuing a report that critiques the ITAA results based on its survey response rates and provides arguments similar to Professor Lerman's testimony to Congress.

HIGH TECHNOLOGY INDUSTRIES

There are nine California high technology industry groups where we expect to find a substantial number of information technology (IT) workers.

These include the three aerospace manufacturing industries:

- Aircraft & parts,
- Missiles, spacecraft and parts, and
- Search and navigation equipment;

the four electronics manufacturing industries:

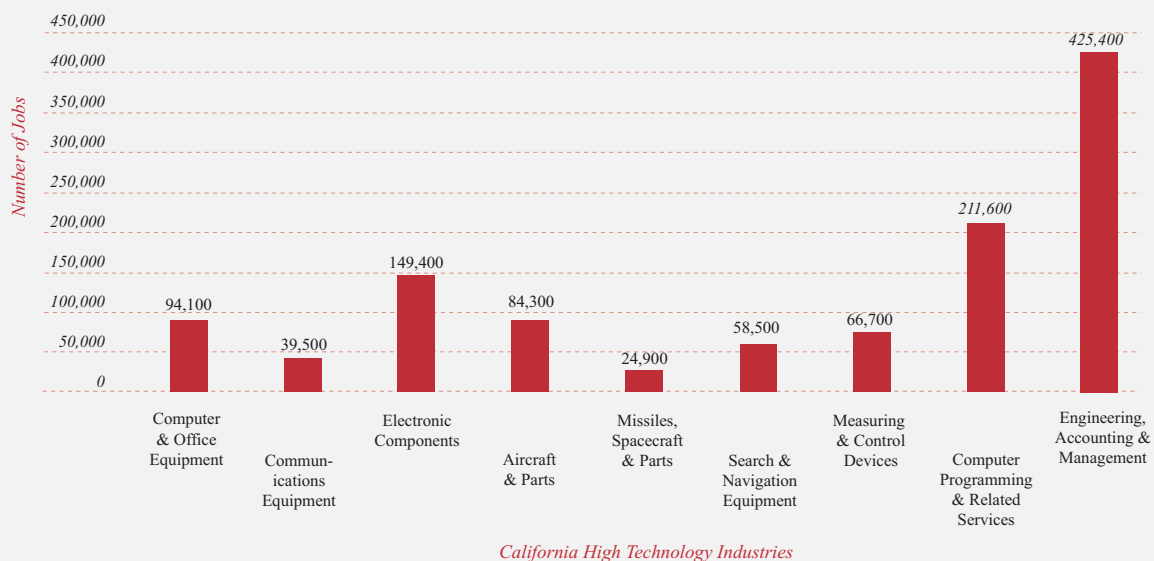
- Computer and office equipment,
- Electronic components,
- Measuring and control devices, and
- Communications equipment;

and two service sector industries:

- Computer programming and related services, and
- Engineering, accounting and management services.

Employment: In 1997, there were a total of 1,154,000 California jobs in these high technology industries, representing 8.7 percent of total nonfarm employment. As [Figure 1](#) shows, the largest employment is in engineering, accounting and management services, followed by computer program-

Figure 1: Employment in California High Technology Industries
(1997 Annual Average)



ming and related services, electronic components and computers and office equipment manufacturing.

Employment in high technology industries expanded by 5.8 percent in 1997, substantially more than job growth economy-wide, which was 3.3 percent. Growth in computer programming and related services was particularly robust, at 14.5 percent. (See [Figure 2](#).)

Moreover, computer programming and related services employment increased continuously through the recent recession. From 1990 to 1997, the number of jobs in computer programming nearly doubled, while total nonfarm job growth was just 5.3 percent. Overall, high technology employment declined by 1.9 percent due to lasting declines in aerospace manufacturing. Employment in 1997 was above 1990 levels in computer programming, engineering services, communications equipment manufacturing, and electronic components manufacturing.

As shown in [Table 1](#), the distribution of high technology industries by size varies by industry. The two industries with the largest number of employees in information technology occupations—computer programming and related services and engineering, accounting and management services—are dominated by small businesses, with 50 and 57 percent respectively, of the employment in firms with less than 100 employees. Approximately 70 percent of the firms in these two categories have less than five employees.

Occupational Staffing Patterns: Using the results of our statewide survey of occupations and wages across all industries, a table was developed to show where eight IT professional occupations are employed in nine high technology industries. Estimated employment in California for these IT workers in 1996-97 was approximately 255,000, with an estimated 166,000 of them working in the nine specific industry groupings which we have considered the high technology industries. (See [Table 2](#).)

Figure 2: Employment Growth in California High Technology Industries (1996 to 1997 Annual Average)

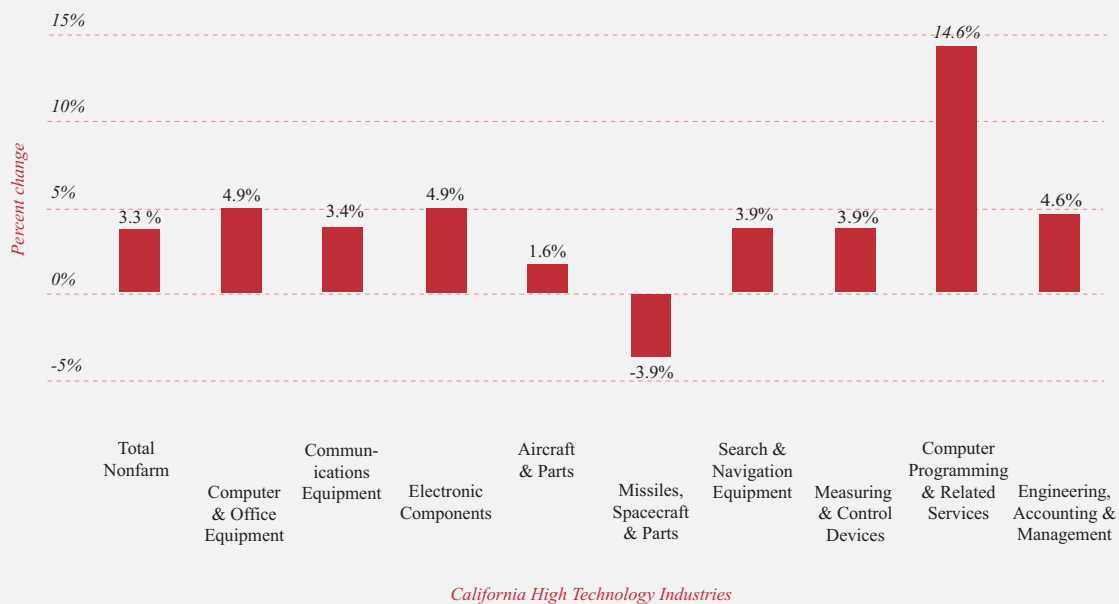


Table 1: Size of Establishments in California High Technology Industries (1)
(July - September 1996)

Distribution of Payroll Employment (2)											
SIC	Industry	Total	Number of Employees in Reporting Unit								1000 or more
			0-4	5-9	10-19	20-49	50-99	100-249	250-499	500-999	
357	Computer & Office Equipment	100%	1%	1%	2%	4%	6%	11%	11%	17%	47%
366	Communications Equipment	100%	1%	1%	3%	9%	12%	23%	19%	16%	16%
367	Electronic Components	100%	1%	1%	3%	9%	12%	23%	14%	18%	20%
372	Aircraft & Parts	100%	0%	1%	2%	6%	5%	10%	9%	4%	62%
376	Missiles, Spacecraft & Parts	100%	0%	0%	1%	2%	1%	6%	6%	15%	68%
381	Search & Navigation Equipment	100%	0%	0%	1%	2%	4%	6%	8%	24%	55%
382	Measuring & Control Devices	100%	1%	2%	4%	9%	11%	14%	13%	13%	33%
737	Computer Programming & Related Services	100%	6%	6%	9%	15%	14%	20%	11%	9%	11%
87	Engineering, Accounting & Management	100%	10%	9%	10%	16%	12%	17%	10%	6%	10%

Distribution of Reporting Units (3)											
SIC	Industry	Total	Number of Employees in Reporting Unit								1000 or more
			0-4	5-9	10-19	20-49	50-99	100-249	250-499	500-999	
357	Computer & Office Equipment	100%	39%	13%	13%	14%	7%	7%	3%	2%	2%
366	Communications Equipment	100%	35%	11%	13%	17%	11%	9%	3%	1%	1%
367	Electronic Components	100%	29%	13%	14%	19%	11%	10%	3%	2%	0%
372	Aircraft & Parts	100%	29%	14%	16%	22%	8%	7%	2%	1%	1%
376	Missiles, Spacecraft & Parts	100%	22%	11%	21%	18%	4%	11%	5%	5%	4%
381	Search & Navigation Equipment	100%	31%	10%	11%	16%	11%	7%	5%	7%	3%
382	Measuring & Control Devices	100%	36%	14%	15%	17%	9%	5%	2%	1%	1%
737	Computer Programming & Related Services	100%	66%	13%	9%	7%	3%	2%	0%	0%	0%
87	Engineering, Accounting & Management	100%	70%	14%	8%	5%	2%	1%	0%	0%	0%

Source: California Employment Development Department, Labor Market Information Division, ES 202 Program.

Notes:

- (1) Data universe is all employment subject to the Unemployment Insurance provisions of the California Unemployment Insurance Code.
- (2) Employment refers to the number of persons earning wages during the pay period which includes September 12, regardless of payroll period used by each reporting unit.
- (3) A reporting unit is an economic unit or establishment primarily performing one economic activity, usually at one physical location.

The industry with the highest proportion, as well as the largest number, of these workers is business services, specifically in computer programming and related services (44.5 percent, 86,900 employees). Substantial numbers of IT professionals are also found in the engineering, accounting and

management consulting services industries (25,300) as well as in manufacturing sectors which include computer and office equipment (11,100), electronic components (10,800), and search and navigation equipment (13,700).

Table 2: Number of Employees in Information Technology Occupations Within California High Technology Industries
(October - December 1996)

Occupations	High Technology Industries										Total — All Other Industries	Total — All Technology Industries
	Computer & Office Equipment	Communi- cations Equipment	Electronic Components	Aircraft & Parts	Missiles, Spacecraft & Parts	Search & Navigation Equipment	Measuring & Control Devices	Computer Programming & Related Services	Engineering, Accounting & Management			
• Electrical & Electronic Engineers	4,075	4,082	6,084	163	1,241	11,250	1,754	6,065	4,818	39,532	12,848	52,380
• Computer Engineers	4,692	1,617	2,937	11	4,954	898	695	16,363	3,900	36,067	133	36,200
• Systems Analysts	753	144	197	60	343	471	242	17,818	2,592	22,620	38,657 (1)	101,250 (2)
• Computer Programmers	992	42	830	78	687	608	566	30,717	5,453	39,973		
• Data Base Administrators	103	134	119	—	138	71	205	2,357	660	3,787	4,723	8,510
• Computer Support Specialists	484	348	495	75	180	235	52	7,803	4,792	14,464	22,636	37,100
• Computer Programmer Aides	—	75	83	4	—	69	—	3,168	729	4,128	5,892	10,020
• All Other Computer Scientists	10	—	99	—	—	—	81	2,586	2,382	5,158	4,042	9,200
• Total — IT Occupations	11,109	6,442	10,844	391	7,543	13,602	3,595	86,877	25,326	165,729	88,941	254,660
• Total — All Occupations	90,137	38,055	137,175	81,428	26,731	61,105	65,005	195,238	428,914	1,123,788	11,514,994	12,638,782
• % of IT Workers	12.32%	16.93%	7.91%	0.48%	28.22%	22.26%	5.53%	44.49%	5.90%	14.75%	0.77%	2.01%

Source: Occupational Employment Statistics (OES) Survey, 1996-1997. Data on occupations within industries are preliminary and do not meet U.S. Bureau of Labor Statistics publication standards for survey response rates or relative error calculations.

Notes:

- (1) The total Systems Analysts and Computer Programmers in "All Other Industries" is derived from subtracting the total in the 9 industries of 62,593 from the overall total of 101,250.
- (2) Systems Analysts and Computer Programmers are combined in the total estimates for "All Industries", but were broken out in high technology industry estimates.

OCCUPATIONAL GROWTH TRENDS IN HIGH TECHNOLOGY

Occupational growth rates are forecasted by applying occupational staffing patterns for each industry collected from the Occupational Employment Statistics survey to LMID's industry growth projections.

In general, our industry growth projections are conservative in that they are based on long-term trends and do not anticipate shorter term business cycle fluctuations. Our statewide projections for all occupations in the period 1993-2005 reflect a growth of approximately 570,000 annual job openings. Table 3 shows occupational projections for information technology occupations. Two occupations — systems analysts and computer engineers are projected to grow much faster than all occupations in California.

Computer engineers are projected to be the fastest growing occupation in California

from 1993-2005, with job openings growing by 131 percent. We forecast that 29,360 new jobs will be added during the projection period. Another 5,990 net replacement jobs are also expected to become available. (Net replacement jobs are made available when incumbents leave the occupation due to retirement, change of occupation, or other personal reasons.) (Annual job openings = 2,950)

Systems analysts are also projected to grow quickly in California, with job openings growing by 117 percent from 1993-2005. We forecast 43,170 new jobs and 9,610 net replacement jobs will be added during the

Table 3: California Projections for Selected Information Technology Occupations

Occupations	1993	2005	Growth	Net Replacement	Change in Job Openings*	1993-2005 % Change	Annual Change
• Systems Analysts	45,310	88,480	43,170	9,610	52,780	117%	4,400
• Computer Engineers	27,030	56,390	29,360	5,990	35,350	131%	2,950
• Computer Programmers, including aides	66,840	78,540	11,700	24,970	36,670	55%	3,060
• Electrical and Electronic Engineers	68,100	87,240	19,140	21,410	40,550	60%	3,380
• All Occupations	12,045,300	15,271,500	3,226,200	3,639,980	6,866,180	57%	572,181

Source: EDD, Labor Market Information Division. California Projections and Planning Information, 1996. Table 8, pp. D-29-45.

* Change includes the sum of growth and net replacement.

projection period. (Annual job openings = 4,400)

The growth in job openings for computer programmers (and aides) is projected to be 55 percent between 1993-2005, including 11,700 in growth and 24,970 in net replace-

ments. For this occupation, net replacements will greatly exceed job growth. (Annual job openings = 3,060)

Electrical and electronic engineers job openings are expected to grow by 60 percent to include 3,380 annual openings.

Figure 3: Average Annual Pay per Employee in California High Technology Industries (1996 Annual Average)

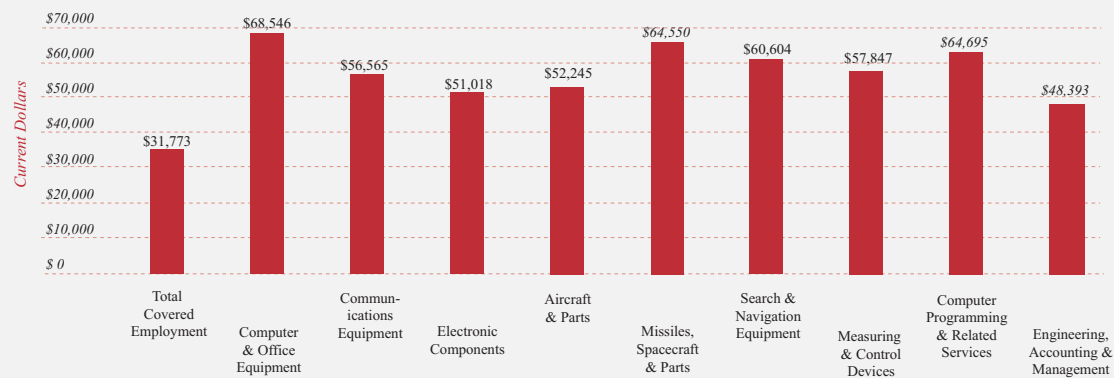
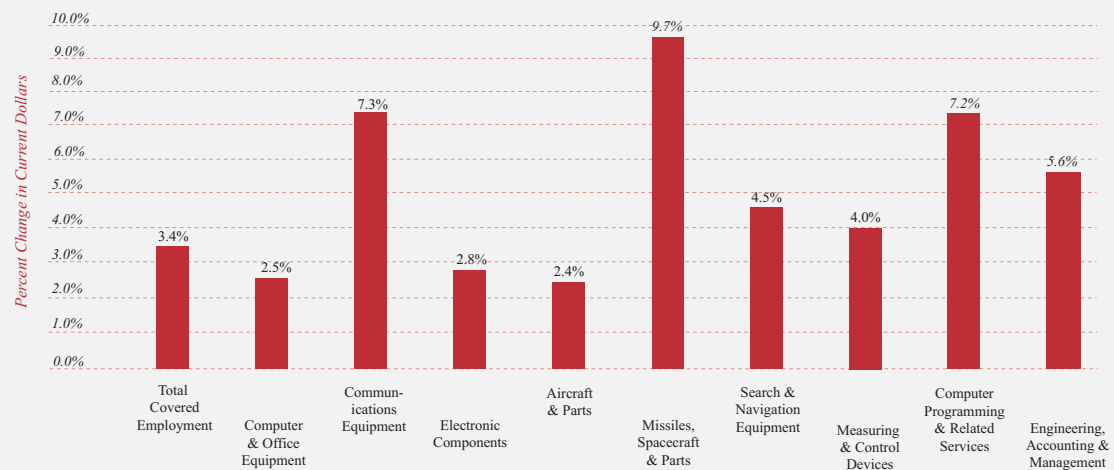


Figure 4: Growth in Annual Wages per Employee in California High Technology Industries (Percent Change, 1995 to 1996, Annual Average)



EVIDENCE OF LABOR MARKET SUPPLY PROBLEM

At LMID, we reviewed two sources of data for evidence of labor supply problems — wages paid in the high technology industries and surveys that ask employers about recruitment difficulties.

Wages: In 1996, annual wages per employee in each of the high technology industries were substantially greater than for covered employment in all industries. Annual wages of \$65,000 in computer programming and related services are more than twice the level of wages in all covered employment (\$32,000). (“Covered” employment includes jobs subject to unemployment insurance reporting requirements.) (See [Figure 3.](#))

As would be expected in an industry experiencing labor shortages, wages in computer programming and related services have grown very rapidly in recent years. In 1996 alone, annual wages per employee

rose 7.2 percent in computer programming and related services, while wages in all covered employment rose 3.4 percent and the private industry employment cost index in western states rose by 3.4 percent. (See [Figures 4 and 5](#) and [Table 4.](#))

[Table 4](#) provides historical employment and annual wage data for California high technology industries. [Table 5](#) provides recent hourly wage data for selected information technology and other occupations. While wage data do not prove that there are labor shortages or surpluses, per se, they do indicate relative scarcity of labor and the attendant clearing price for occupations.

Figure 5: Growth in Annual Wages per Employee in California Computer Services Compared to Economy-Wide (Calendar Years 1989 - 1996)

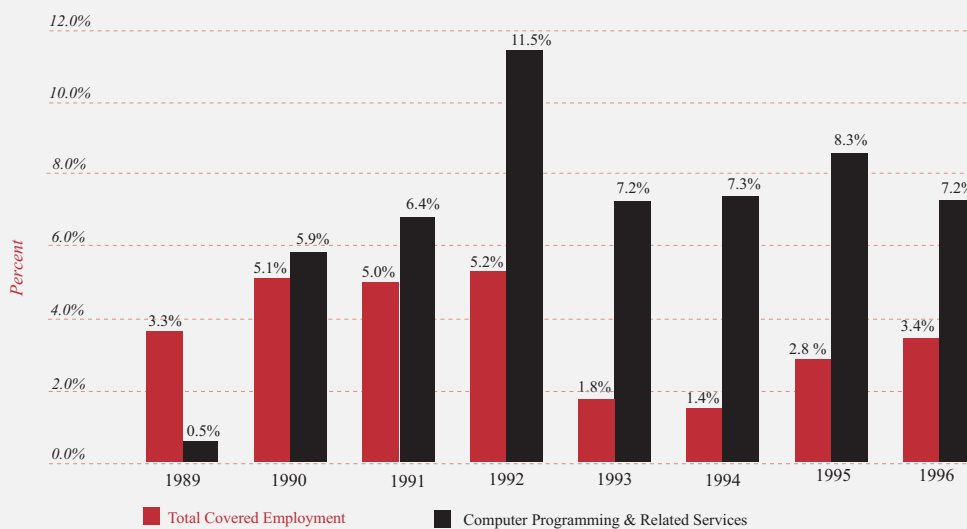


Table 4: Employment and Annual Wages in California High Technology Industries
(Calendar Years 1988 - 1997)

Annual Average Employment (Number of Jobs)											
SIC	Industry	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	Total Nonfarm	11,911,500	12,238,500	12,499,900	12,359,000	12,153,500	12,045,300	12,159,500	12,422,200	12,743,400	13,167,100
357	Computer & Office Equipment	100,300	103,100	100,800	101,300	95,100	92,000	83,100	85,100	89,700	94,100
366	Communications Equipment	30,900	31,700	30,500	29,000	30,100	30,700	30,700	34,800	38,200	39,500
367	Electronic Components	144,200	142,800	138,900	132,500	122,200	118,400	120,400	128,900	142,400	149,400
372	Aircraft & Parts	159,600	161,400	162,300	145,800	132,200	108,100	92,700	84,400	83,000	84,300
376	Missiles, Spacecraft & Parts	79,900	77,900	75,700	68,100	57,900	46,600	36,200	28,900	25,900	24,900
381	Search & Navigation Equipment	123,600	111,700	99,300	94,100	84,000	70,700	61,400	55,400	56,300	58,500
382	Measuring & Control Devices	69,200	71,500	69,500	67,500	62,900	60,700	59,500	61,200	64,200	66,700
737	Computer Programming & Related Services	96,500	105,700	107,100	114,900	120,900	124,500	136,500	159,800	184,700	211,600
87	Engineering, Accounting & Management	340,100	365,400	392,600	397,500	390,300	383,400	389,200	397,900	406,800	425,400
Annual Wages per Employee (Current dollars)											
SIC	Industry	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	Total Covered Employment	\$24,124	\$24,921	\$26,180	\$27,499	\$28,934	\$29,468	\$29,878	\$30,716	\$31,773	not available
357	Computer & Office Equipment								\$66,854	\$68,546	not available
366	Communications Equipment								\$52,694	\$56,565	not available
367	Electronic Components								\$49,620	\$51,018	not available
372	Aircraft & Parts								\$51,000	\$52,245	not available
376	Missiles, Spacecraft & Parts								\$58,864	\$64,550	not available
381	Search & Navigation Equipment								\$57,977	\$60,604	not available
382	Measuring & Control Devices								\$55,621	\$57,847	not available
737	Computer Programming & Related Services	\$38,423	\$38,599	\$40,875	\$43,471	\$48,451	\$51,949	\$55,719	\$60,329	\$64,695	not available
87	Engineering, Accounting & Management								\$45,815	\$48,393	not available
Change in Annual Average Employment (Percent change)											
SIC	Industry	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	Total Nonfarm		2.7%	2.1%	-1.1%	-1.7%	-0.9%	0.9%	2.2%	2.6%	3.3%
357	Computer & Office Equipment		2.8%	-2.2%	0.5%	-6.1%	-3.3%	-9.7%	2.4%	5.4%	4.9%
366	Communications Equipment		2.6%	-3.8%	-4.9%	3.8%	2.0%	0.0%	13.4%	9.8%	3.4%
367	Electronic Components		-1.0%	-2.7%	-4.6%	-7.8%	-3.1%	1.7%	7.1%	10.5%	4.9%
372	Aircraft & Parts		1.1%	0.6%	-10.2%	-9.3%	-18.2%	-14.2%	-9.0%	-1.7%	1.6%
376	Missiles, Spacecraft & Parts		-2.5%	-2.8%	-10.0%	-15.0%	-19.5%	-22.3%	-20.2%	-10.4%	-3.9%
381	Search & Navigation Equipment		-9.6%	-11.1%	-5.2%	-10.7%	-15.8%	-13.2%	-9.8%	1.6%	3.9%
382	Measuring & Control Devices		3.3%	-2.8%	-2.9%	-6.8%	-3.5%	-2.0%	2.9%	4.9%	3.9%
737	Computer Programming & Related Services		9.5%	1.3%	7.3%	5.2%	3.0%	9.6%	17.1%	15.6%	14.6%
87	Engineering, Accounting & Management		7.4%	7.4%	1.2%	-1.8%	-1.8%	1.5%	2.2%	2.2%	4.6%
Growth in Annual Wages per Employee (Percent change)											
SIC	Industry	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
	Total Covered Employment		3.3%	5.1%	5.0%	5.2%	1.8%	1.4%	2.8%	3.4%	not available
357	Computer & Office Equipment									2.5%	not available
366	Communications Equipment									7.3%	not available
367	Electronic Components									2.8%	not available
372	Aircraft & Parts									2.4%	not available
376	Missiles, Spacecraft & Parts									9.7%	not available
381	Search & Navigation Equipment									4.5%	not available
382	Measuring & Control Devices									4.0%	not available
737	Computer Programming & Related Services		0.5%	5.9%	6.4%	11.5%	7.2%	7.3%	8.3%	7.2%	not available
87	Engineering, Accounting & Management									5.6%	not available

Source: California Employment Development Department, Labor Market Information Division

Notes:

- (1) Employment for all but computer programming and related services is payroll employment estimated by the Current Employment Statistics (CES) Program.
- (2) Employment in computer programming and related services is estimated by applying the ratio of computer programming and related services employment to business services employment from the US Bureau of Labor Statistics (BLS), Employment and Wages, Annual Averages (known as ES202) to the estimated employment in business services from the CES Program.
- (3) Annual wage per employee is calculated by dividing total annual wage by annual average employment from the ES202.

EMPLOYER SURVEYS

In our local partnership program designed to study occupations selected for promising growth in employment and opportunities in training, we have compiled data on information technology occupations, mostly computer-related jobs.

One of the questions asked of employers is an attempt to assess the *supply and demand* for the occupation. We ask about their experience in finding applicants for their jobs, or what is the local supply to match their demand?

In surveys of 654 firms throughout the state that employ 14,665 computer programmers, systems analysts, computer engineers, and/or software engineers, we asked how difficult it is for them to find these qualified, experienced computer professionals. *In the period 1994 through 1996, two-thirds of employers surveyed reported that it was moderately to very difficult to find qualified*

and experienced applicants to fill these positions.

In the same surveys, comparable difficulty was reported in finding qualified but inexperienced applicants as well. *While it is generally easier to find inexperienced workers, a quarter to a half of the 654 employers still reported that it was moderately to very difficult to find computer programmers, systems analysts, computer engineers and/or software engineers.*

We also aggregated information about the data processing management and network support occupations surveyed locally

Table 5: Hourly Wages Paid to Employees in Selected Occupations Statewide Across All Industries

<i>Information Technology Occupations</i>	<i>Mean</i>	<i>Median</i>
<i>Computer engineers</i>	28.66	28.99
<i>Computer programmer aides</i>	17.59	15.70
<i>Computer support specialists</i>	20.17	18.78
<i>Data base administrators</i>	24.45	23.69
<i>Electrical and electronic engineers</i>	27.71	28.65
<i>Systems analysts/computer programmers</i>	26.21	24.51
<i>All other computer scientists</i>	28.35	29.63
<i>Other Professional Occupations</i>	<i>Mean</i>	<i>Median</i>
<i>Biological scientists</i>	20.96	19.01
<i>Chemists, except biochemists</i>	23.33	21.14
<i>Economists, including market research analysts</i>	27.91	24.72
<i>Engineering, mathematical, and natural sciences managers</i>	36.13	38.40
<i>Lawyers</i>	36.61	37.81
<i>Mechanical engineers</i>	24.72	24.72
<i>Operations and systems researchers and analysts, excluding computer</i>	21.07	19.59
<i>Sales engineers</i>	27.69	27.83
<i>Sales reps, scientific and related products and services excluding retail</i>	22.73	20.30

Source: EDD, Labor Market Information Division. Occupational Employment Statistics (OES) Survey for 1996-97.

around the state, such as network administrators, website designers and developers, and network managers and technicians. *In separate surveys of 225 employers who had 691 workers in these occupations, again, about two-thirds of employers reported it was moderately to very difficult to find qualified applicants.*

Because many of our local partners and employers are interested in specialized occupations, surveys of such occupations as computer animators, computer aided audio-

visual engineers, and multimedia software developers and specialists were conducted in the period 1994 through 1996. *Of the 66 employers who employ 592 workers in these specialized occupations, over three-quarters of these firms reported that it was moderately to very difficult to find experienced professionals for their jobs.* Even inexperienced workers in these specialized occupations were not easy to find. Nearly half the employers reported difficulty finding qualified applicants for these occupations.

O B S E R V A T I O N S

Based on the wage increases in high technology industries and our employer survey results, there is an increasing demand for information technology workers.

The labor market for such professionals is tight and is responding with increasing wages, and recruitment of foreign workers. Clearly, our projections indicate that the demand for such workers is rising.

At least some of the increasing demand is the result of programming needs to resolve the Year 2000 or Millennium problem. Another possible reason is that the opportunities for computer professionals to move up and start their own businesses are great. The Gartner Group, an Information Technology consulting firm, indicates that 50 to 60 percent of departing IT professionals go into business for themselves or work for an external provider. Employers are therefore competing against the general success of their industry.

On the other hand, the potential labor pool for high technology industries is supplied by students and graduates from non-technical

programs. The National Software Alliance estimates that only 37 percent of programmers and other service workers are computer science graduates. The remaining 63 percent are from other fields (52 percent) and noncitizens (11 percent). Many graduates who do not have computer science credentials are hired for information technology jobs. Therefore, a simple count of graduates from technical programs such as electrical engineering or computer sciences will undercount the pool of labor available to meet industry needs.

In summary, the labor market for information technology professionals is clearly tightening and is expected to tighten further. Wages are rising and opportunities for starting businesses are promising, creating wealth for the individuals in demand and consequent recruiting and placement costs for the industry.



Pete Wilson, Governor
State of California

Sandra R. Smoley, R.N., Secretary
Health and Welfare Agency

Ray Remy, Director
Employment Development Department

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